A GUIDE TO THE URINARY CABINET, &c.

By Robert Venables, M.B.

This pamphlet is intended as a companion to a "Urinary Cabinet" constructed by Messrs. George Knight and Co. The cabinet contains an apparatus, and all the tests necessary for an elaborate series of experiments on the urine, and represents, on a large scale, the portable case of Mr. Ronketti. The directions furnished by the author of the pamphlet, as a guide to the experimentalist on urinary secretions, are clear and practical, and we think that the following condensed account will serve as an useful article for reference:—

Before we attempt any investigation of the properties of urine in a disordered state, we should make ourselves acquainted with the general appearance and properties of healthy urine, and the reagencies produced by the different tests.

Urine which has a yellow or deep orange-red color indicates a mal-distribution of the bile, and denotes a tendency to, if not actual jaundice. Copper-colored urine, which is or becomes remarkably transparent on cooling, indicates acidity of this excretion, and a tendency to deposit lithic acid in the crystallised form. Citron-colored, or yellowish-green colored, remarkably transparent, with an acidulous reaction, denotes the oxalate of lime diathesis. Pale straw-colored urine, or of a blueish-green tint, and having the smell of new hay, denotes sugar, and the presence of diabetes, in some one or other of its forms. Opalescent oily-looking urine, having a peculiar animal odor, also resembling that of the sweet or wild briar, denotes the cystic oxide diathesis. Pale-colored, wheyish-looking urine, opalescent, when passed, and having a strong peculiar urinous smell, is generally neutral, and soon becomes alkaline; it denotes a tendency to the phosphates. Very clear, colorless, transparent urine, devoid of smell and almost of taste, is generally copious, watery, and of very low specific gravity, showing a tendency to hysteria, and various other nervous affections, as well as spasm. Urine of this sort also often contains a large proportion of the alkalies, mostly carbonated. Urine perfectly transparent when passed, but becoming cloudy as it cools, and finally depositing reddish, yellow, or cream-colored sediments, shows a predominance of lithate of ammonia, and the sediment will readily dissolve on the application of heat. Urine cloudy when passed, and remaining so after filtration, but which, on being heated after the addition of a little acetic acid, becomes opaque, and deposits a solid coagulum, contains albumen in some one or other of its modifications. Urine transparent when warm, but which on cooling deposits a sediment, and being heated becomes again transparent, but on continuing the heat becomes cloudy, and ultimately deposits a coagulum, owes these properties to lithate of ammonia in excess, with albumen. A very slight degree of temperature dissolves the lithate, but it requires a temperature of between 150° or 160° Fah. to coagulate the albumen, the double opalescence, with intervening transparency, arising from the different degrees of temperature. Transparent urine, becoming cloudy on the application of heat, will be found to owe that property to holding the phosphates, and probably some carbonate of lime in solution by carbonic acid in large excess.

The specific gravity of urine is ascertained by immersing the urinometer, and allowing it to remain in the fluid for a few seconds, when the specific gravity is read off, by inspection of the figures on the stem. The following precautions are essential to accuracy and precision:—The instrument should be perfectly clean, and free from all grease, oily, mucilaginous, saccharine, and saline particles, the adhesion of which affect the delicacy of the instrument. The urine, too, should be free from all bubbles of air, which, by attaching themselves to the instrument, would give it a greater degree of buoyancy, and consequently a false estimate. The temperature also should be taken, and this should be allowed to approach the ordinary standard, say between 50° and 60°, before the specific gravity be finally determined. Urine below 1.010, very copious, clear, and like spring water, infers defective digestion, attended with a cold phlegmatic constitution. Often, too, the alkalies predominate. Copious, pale-colored urine, of specific gravity between 1.015 and 1.020, denotes spasm; indeed, urine copious, like spring water, and of low specific gravity from 1.000 nearly to 1.015, indicates a leucophlegmatic habit, a watery, serous condition of blood, and what would be designated an anæmious condition of the system. Such urine also frequently contains imperfectly elaborated chyle. To these, however, there are some exceptions, which the other conditions of the urine indicate.

Urine of similar properties, but opalescent or wheyish, and neutral, or which speedily becomes alkaline, shows a tendency to the phosphatic diathesis. Phosphatic urine, however, is frequently of much higher gravity —from 1.020 to 1.025—and then frequently abounds in urea. When the specific gravity exceeds 1.018 or 1.020, and the fluid has a deep color, approaching to red, high-colored as it is termed, phlogistic fever, may be considered as habitual, and indigestion, with hepatic derangement, is present. In such instances the alkaline lithates often abound and are deposited. Urine from 1.020 to 1.025 or 30, of an ale or porter color, attended either with diuresis, or with a desire of frequent micturition, indicates excess of urea, a tendency to diabetes, and not unfrequently either hœmorrhoids are troublesome, or the prostate gland is in some degree affected. Urine of a specific gravity of 1.030 (and above more certainly), transparent, of a pale straw-color or blueish green, most unequivocally denotes diabetes, nor does a saline taste alter the facts, for, though saline, sugar may be proved by some of the ordinary methods of search.

The chief mechanical properties of urine are specific gravity and quantity. The former, as has been said, is ascertained by the urinometer, and, if natural, should range between 1.012 and 1.017. The stem of the urinometer is graduated from 0 to 60; and, to understand its application, we should remark that 0 marks the specific gravity of distilled water, and should be read as 1.000; hence the other numbers must be added to 1.000 to express the specific gravity of the fluid examined. Thus, if the surface of the fluid coincide with 35, 40, 43, &c., on the stem of the instrument, the specific gravity of the fluid will be 1.035, 1.040, 1.043, &c.

The specific gravity affords some estimate of the quantity of saline or other principles held in solution by the urine. But as the temperature influences the specific gravity, this should always be determined by means of the thermometer. An elevated temperature, in many instances, reduces the specific gravity of a fluid or solution; but the urine frequently abounds in saline principles, &c., soluble while the urine is hot, but separating as it cools. In such cases, provided the urinometer be used for the purpose, the specific gravity should be taken while the urine is yet hot, and again when it shall have deposited its insoluble salts, and it will often happen that the gravity under these circumstances will differ by some decimals. Therefore the thermometer is essential where accuracy and precision are required.

The ordinary temperature of healthy urine may be estimated at 92° Fah., and the quantity passed in twenty-four hours at from forty to fifty ounces. Having ascertained these sensible properties, we proceed to the chemical examination of the urine, and the first step is to ascertain if it be acid or alkaline. This is readily done by the well-known tests of litmus and turmeric paper.

The excess or deficiency of any of the principles contained in the urine may next be ascertained; but, as a standard of comparison, we must bear in mind the composition of healthy urine. According to the analysis of Berzelius, urine consists of—

Water		933.00
Animal and destructible principles.	Urea	30.10
	Lithic acid	1.00
	Free lactic acid? Lactate of ammonia and animal matters inseparable from the above (osmazome soluble in alcohol; extractive, soluble in water)	17.14
	(Vesical) mucus	0.32
Alkaline and earthy salts.	Sulphate of potass	3.71
	„ soda	3.16
	Phosphate of soda	2.94
	„ ammonia	1.65
	Muriate of soda (chloride of sodium?)	4.45
	ammonia (hydrochlorate)	1.50
	Earthy phosphates with a trace of fluate of lime (fluoride of calcium?)	1.00
	Silex	.03

We shall take the preceding principles in order, and endeavour to give a brief description of the several processes by which they may be detected. The normal quantity of water is to be determined by the quantity passed in a given time and the specific gravity. If not more than forty ounces of the usual specific gravity be passed in twenty-four hours we may conclude the watery portion to be in the normal proportion.

Urea.—The normal proportion of this principle is about 30½ parts in 1000 parts of urine. But this principle may be unnaturally increased or diminished. When in the normal proportion no crystallisation takes place on the addition of nitric acid, even after a considerable interval; but when urea is in excess, crystallisation takes place very speedily after the addition of nitric acid; and the interval between the addition and the crystallisation may be taken as a tolerably fair index of the excess of urea. To examine for this principle a small quantity of urine should be placed in one of the glass capsules, and with the dropping tube nearly an equal quantity of nitric acid should be allowed to trickle along the concave surface of the capsule, so as to pass under and float the urine upon its surface. If urea be present in excess, crystallisation will take place more or less speedily, in proportion to the excess. Urine abounding in urea has generally a high specific gravity, from 1.020 to 1.030. Hence, the specific gravity is frequently an indication of an excess of urea.

Urea may be deficient, and this condition is frequently associated with the presence of foreign matters, especially sugar, in the urine. If the watery portion of the urine be increased, the quantity of urea, as well as of the other principles, will be relatively, not positively, reduced. Such cases will be readily distinguished by the reduced specific gravity and increased quantity of the urine. The best method of estimating a real deficiency of urea is either to evaporate the urine at a gentle heat to one-half or two-thirds, then, the quantity of water being reduced, if no crystallisation takes place on the addition of nitric acid, urea may be considered as deficient.

Lactic acid exists in the urine generally in combination with ammonia; but when the urine abounds in other acidulous principles, the lactic acid being separated from its base, attacks the lithic compounds, and, combining with the base, sets the lithic acid free. It may thus become a cause of lithic acid gravel, or of the formation of a lithic acid calculus.

Lactic acid may be detected in various ways, but, as the processes are complex, we must refer the reader to chemical works.

Lithic acid always exists in healthy urine, in combination with ammonia; but its affinities are so weak that, if any dilute acid be added to the fluid, the lithic acid separates mostly in the crystallised form.

Dilute nitric acid decomposes and dissolves lithic acid, with effervescence. The solution, when slowly evaporated, leaves a pink stain, which becomes a rich purple on addition of liquid ammonia. This is the special test of the presence of lithic acid, both free and combined, even when it exists in very minute proportion. One of Griffin's white capsules, in the shape of a teaspoon, answers well for the experiment.

Lithate of ammonia, also, is much more soluble in hot than in cold menstruums. Hence, urine surcharged with lithate of ammonia will preserve its transparency while hot, the lithate being completely soluble at this temperature, but become turbid on cooling, owing to the lithate becoming insoluble, and consequently separating; we recognise, therefore, the alkaline lithates by this peculiar property. The urine, when first passed, is perfectly transparent and free from cloud or sediment; as it cools it becomes cloudy, and ultimately the precipitated lithate of ammonia subsides, leaving the urine clear and cloudless above. A portion of the urine agitated so as to diffuse and suspend the lithate, heated in the capsule over the spirit-lamp, gradually becomes transparent, and the whole of the salt is dissolved, separating again as the urine cools. Indeed the lithic acid may be separated in its characteristic form by the addition of any dilute acid at the temperature of solution. The above properties will distinguish these sediments from the phosphates, which sometimes subside from diffusion through the urine.

Urine abounding in lithic acid is mostly scanty, high colored, and of considerable specific gravity. It is in general associated with the phlogistic diathesis or inflammatory state of the system.

The lithates are deposited under three different aspects—namely, yellow or cream colored, the red, and the pink. Dr. Prout looks upon the lithic compounds as derived from the albuminous principles of the chyle and blood, as well as from the decomposition of the albuminous textures themselves. Hence, a knowledge of their nature, independently of the information they afford relative to the diseased states of the urine, frequently throws considerable light upon the derangements of the digestive process, and their specific nature.

Mucus.—The bladder and urinary organs are lined, like many others, with a peculiar membrane named mucous, and which secretes a peculiar principle, termed mucus, which serves to protect the part from the irritant action of the fluids either contained or transmitted. This mucus in the healthy state is so small in quantity that it has little or no effect upon the appearance of the urine. After rest, however, it is often observed to have subsided, either occupying the bottom of the vessel or remaining suspended as a mass at different depths. It is not an object of any importance unless it have become excessive in quantity, or vitiated in quality—circumstances to be noted hereafter.

Potass and Soda.—To determine the excess of the two fixed alkalies, the best plan is to convert them into *chlorides* by a solution of neutral chloride of barium. Insoluble salts of baryta will be formed, from which the alkaline chlorides may be separated by mere decanting or filtration. On concentrating the solution, the potass may be precipitated by excess of tartaric acid and its quantity be thus estimated. The chloride of sodium may be obtained by subsequent evaporation.

When greater accuracy is necessary, the compound solution of the mixed chlorides may be evaporated and then exposed to the action of spirits of wine containing about 60 per cent. of alcohol. The chloride of sodium will be dissolved out, and its quantity estimated by evaporation; the chloride of potassium may be dissolved, and precipitated by tartaric acid as before.

Ammonia exists naturally in the urine in combination with phosphoric, and also with hydrochloric acid. The proportions 3.15 in 1000. Sometimes, however, its quantity is morbidly increased, and it enters into the formation of some species of calculi. It also is found as carbonate, derived, in fact, from the decomposition of urea, which is readily converted into carbonate of ammonia by the fixed alkalies, which are found in diseased mucus.

Alkaline urine generally indicates a tendency to deposit the phosphates, which it does by neutralising the excess of phosphoric acid by which the earths are rendered soluble. It also indicates frequently a diseased condition of bladder, at least of its mucous coat. When a large quantity of mucus is secreted, and this vitiated in quality, the urine is often highly alkaline when voided, turning turmeric deeply brown; but should it not be so, or only neutral, it very speedily becomes alkaline, exhales a strong ammoniacal odor, and very soon becomes putrid; the specific gravity of such urine is also very various; the urine is often very abundant, opalescent, or sometimes clear, like water. In some cases the specific gravity hardly exceeds that of distilled water; in other cases it amounts to 1.020 or 1.030.

Lime.—Sometimes the quantity of phosphate of lime is increased, or at least the earthy base, when it is found also in combination with other acids, especially the oxalic. Phosphate of lime often forms prostatic concretions, and is also occasionally thrown off, together with the carbonate, from the mucous coating of the bladder.

The quantity of lime in solution may be rendered evident by adding to a portion of the urine a little acetic acid, and afterwards the oxalate of ammonia. The oxalic acid will precipitate the lime as oxalate of lime, and the proportion may be thus readily inferred, by comparing the bulk of the precipitate with the volume of urine used. The addition of acetic acid previously precipitates any lithic acid, if it exist, and the oxalate of ammonia should be added to the decanted or filtered portions. The oxalate of lime precipitates as a white flocculent powder, which by boiling becomes heavy and granular.

Magnesia, when present, precipitates with the oxalic acid as oxalate of magnesia; but if there be much hydrochlorate of ammonia in the solution, the magnesia will not precipitate, because it is soluble in hydrochlorate of ammonia. We, therefore, filter from the oxalate of lime, and precipitate the filtered liquor by carbonate of potass and boiling; carbonate of magnesia will be formed, and will precipitate. These precipitates may be ignited, and the quantity of pure earths thus accurately ascertained; but it is seldom necessary, for practical purposes, to proceed so far.

Tolerably fair estimates of the quantity of earthy bases may be more hastily effected by adding liquor potassæ, which will precipitate them as neutral phosphates; or if liquor ammoniæ be added, the ammonio, or the mixed and fusible phosphates, will be thrown down, which, fused before the blow-pipe, will, by the weight of the bead compared with the volume of urine from which it was obtained, enable us to judge with quite enough precision of the quantity of the earthy bases present in the specimen.

Hydrochloric Acid.—This acid exists combined with ammonia, in the proportion of 1.5 to 1000 parts of urine. We have also 4.45 of chloride of sodium, making in all nearly six parts of the saline compounds of chlorine in 1000 parts of urine. To separate the hydrochloric acid, all that is necessary is to add nitrate of silver, when we shall precipitate the hydrochloric acid as an insoluble chloride. To insure complete accuracy, however, some precautions are necessary. If the urine be alkaline, especially ammoniacal, acetic, or perhaps, preferably, nitric acid in slight excess should be added, otherwise the ammonia would hold the chloride in solution. A little organic matter is precipitated by the oxide of silver, but this is easily got rid of by heating in a Berlin crucible, and treating the residue with a little nitric acid, and washing in distilled water. The insoluble residue will be chloride of silver.

Sulphuric acid may be precipitated by acidulous nitrate of baryta; an insoluble sulphate of the earth will fall down, which may be washed with diluted nitric acid, and afterwards exposed to heat. The weight of the dried mass will afford the means of determining the precise quantity of sulphuric acid.

The acids are of importance, inasmuch as if free, they cause a liberation of lithic acid; and, indeed, a predominance of some of the acids indicates particular diatheses. Thus the predominance of the muriatic acid seems in general to denote a phlogistic or inflammatory state of system, while that of the lactic marks rather a state of irritation.

Foreign Principles.—The foreign principles occasionally found in urine are stated by Dr. Prout to be as follows:—

Separately or as blood { Albumen, Fibrin, Red particles } Of the chyle and blood.
{ Various acids, coloring matters, &c., either formed from, or accompanying the lithic acid.
Nitric acid. }
Xanthic oxide.
Cystic oxide.
{ Sugar.
Oxalic acid.
Carbonic acid. }
Hippuric acid? Benzoic acid?
Prussian blue; Cyanourine; indigo.
Secretion of the prostate gland, &c.
Pus, and perhaps other matter.

We shall examine the above in their order of enumeration.

Blood itself as a whole requires little or no comment; it will be easily recognised by its sensible characters.

Albumen is sometimes in considerable quantity in the urine, insomuch that on being heated it forms almost a solid opaque mass. The addition of nitric acid likewise causes coagulation, especially if assisted by the application of heat. But urine abounding in chyle also coagulates under similar circumstances. When the urine contains coagulable matter in small quantity, the best test is the prussiate—ferro-sesquicyanide of potassium. The urine should be rendered slightly acidulous by a drop or two of acetic acid, and the solution of the prussiate then added. If the urine contain either serum or chyle, a cloud more or less dense and opaque will speedily form and gradually subside.

Serum and chyle seem to coagulate with different degrees of density. When albumen is the coagulable matter, the mass is more solid and tough, whereas chyle affords a more *curdy* light, and, as it were, flocculent precipitate.

An albuminous state frequently prevails after some of the exanthemata, especially scarlet fever. It also prevails in some forms of dropsy, and denotes granular degeneration of the kidneys. Indeed, chylo-albuminous urine is of great moment, inasmuch as denoting certain morbid states of kidney, which it is of importance to recognise.

Fibrin, xanthic, and *cystic* oxides exist chiefly in the form of calculi, and *nitric acid* is of little importance.

Sugar is a principle found in certain diseased states of urine, and especially in diabetes, to which condition the term should be confined. Sugar when in large proportion is known by the sweet taste which it gives to the urine. The specific gravity of saccharine urine is for the most part high; above 1.030.

When sugar is in very small quantity, or that its sensible properties—the sweet taste, for instance—are masked by other matters, then some manipulation becomes necessary to determine the presence or absence of this principle. The urine may be evaporated to dryness, and the extract hardened by continued desiccation. The hard mass treated first with cold alcohol, and afterwards with boiling, which last dissolves the sugar, on evaporation will yield solid sugar.

Diabetic urine also undergoes vinous fermentation; if, therefore, a little yeast be added to diabetic urine, and the temperature favorable, carbonic acid may be disengaged, and alcohol may be distilled or obtained by other well-known processes from the residue.

Runge proposes the following, as both precise and delicate:—The suspected urine is to be evaporated at a very moderate heat to dryness; upon the dry residue, in a porcelain dish or plate, drop sulphuric acid diluted with from six to eight parts of water. If sugar be present, the mass acquires a dark or even black color. Previously, however, it will be proper to free the specimen by adding a solution of acetate of lead, filtering and precipitating the excess of lead by hydro-sulphuric acid gas, and then boiling. The sulphuric acid may now be applied as above directed with much greater certainty.*

Carbonic acid.—This acid is often found in the urine, both in excess and in combination with the alkalies. It is readily disengaged, either by heating the urine or by adding a stronger acid. It may be separated and received over water or mercury. This acid, also, enters into combination with the lime, forming solid urinary concretions of the carbonate of this earth.

Pus.—There is great difficulty in distinguishing pus from diseased mucus.

Bile in urine may be detected by hydrochloric or (still better) by nitric acid, which strikes a green color with urine containing bile.

HERPETIC PRURITUS.

In a very severe case of this obstinate disease which had tormented the patient for twelve years, and occupied the perineum, scrotum, and inner side of the thigh, M. Baroch had recourse to the following treatment with success:—

Iodine, fifteen grains; hydriodate of potass, forty grains; dissolve in five ounces of distilled water, and add spirits of wine, one ounce.

This solution was applied for a few hours, and produced a sensation of burning; the patient was soon relieved, and, with the aid of baths, was cured in three weeks.—*Oest. Med. Wochen.*

* To pass a current of sulphuretted hydrogen, pour a sufficient quantity of the mixture of iron and sulphur from the bottle into the two-necked bottle, add as much water as will form a stiffish paste, and set by in a warm place for two hours. If one part of sulphuric acid, diluted with four or five of water, be poured upon the mass, sulphuretted hydrogen will be generated in abundance, and by the conducting tube may be passed through any fluid.